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RICERCHE ZOOLOGICHE DELLA NAVE OCEANOGRAPHICA
"MINERVA" (C.N.R.) SULLE ISOLE CIRCUMSARDE. XVIII.

FIRST RECORD IN PHREATIC FRESHWATER OF
HARPACTICOIDS BELONGING TO THE GENUS
ARENOPONTIA (CRUSTACEA, COPEPODA) AND
DESCRIPTION OF TWO NEW SPECIES.

During the frequent zoological expeditions around the small circumsardinian island of the C.R.N. ship "Minerva", samples of meiobenthos from subterranean waters were collected. This work is concerned with two new species of Cylindropsyllidae belonging to the genus *Arenopontia*; the first species has been collected during the expedition mentioned above; the second species has been collected during researches concerning subterranean waters of Central Italy. It seemed useful to us to describe and discuss the two species together because they show interesting similarities not only in their taxonomical aspect, but also in their ecology, as it will be further explained.

CYLINDROPSYLLIDAE Sars, Lang.

***Arenopontia* (*Neoleptastacus*) *phreatica* n.sp.**

MATERIAL - 1 male, collected in La Maddalena island (Sassari province, Sardinia), (V. Cottarelli legit, 4.6.1988) from an artesian well (73 mt. deep, 53 mt. o.s.l.) located in Casale Susini locality, along

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the road that links up the chief town with Cala Spalmatore (Cottarelli, 1989).

TYPES - Holotype: the male mentioned above, dissected and mounted on a slide labelled *Arenopontia phreatica* ht. The holotype is temporarily conserved in the senior Author's collection at the "Dipartimento di Scienze Ambientali", Università della Tuscia, Viterbo.

DIAGNOSIS - A small *Arenopontia* partially related to *A. speluncae* n. sp., characterized among other things by the morphology of the caudal rami and the morphology and ornamentation of P5 and of endopods in P2 and P4, which are armed with only one apical seta.

DESCRIPTION OF THE HOLOTYPE ⁽²⁾ - Body cylindrical and lengthened, colourless, photoreceptors absent. Body length from the tip of the rostrum to the distal edge of the caudal rami: 0,287 mm. The distal edge of the somites is smooth.

Rostrum (Fig. 1,a): smooth and somewhat shorter than the first segment of the antennula.

Anal operculum (Fig. 1,o): with smooth and curved edge.

Caudal rami (Fig. 1,o): lengthened, longer than the last abdominal segment, ending with a strong curved tip, with a main apical seta surrounded by two shorter setae; two long setae and an aesthetasc can be observed dorsally.

Antennula (Fig. 1,a): seven-segmented, second segment with an hairy seta; fourth segment enlarged, with a long aesthetasc.

Antenna (Fig. 1,f): the rest of the primitive joint between the basis and the first segment of the endopod can be seen. Exopod one-segmented with a slender seta and a spinula on the distal edge; the last segment of the endopod with three short lateral spines; three strong geniculated setae and one shorter can be distally seen.

Mandible (Fig. 1,b): praecoxa with bidentate *pars incisiva*; mandibular palp two-segmented, the first segment with a slender distal seta, the second one with two apical and two shorter subapical setae.

Maxillula (Fig. 1,d): arthrite of the praecoxa with four distal

(2) The diagnosis and description of the new species must be considered as preliminary because females are until now unknown.

addenda; coxa with two apical setae; basis with three apical setae; endopod reduced to a seta.

Maxilla (Fig. 1,g): endopod reduced to a tubercle with two setae; basis prolonged in a strong claw, accompanied by a seta; two endites, with two distal setae each one.

Maxilliped (Fig. 1,r): basis and first segment of the endopod smooth; second segment of endopod with a distal claw.

P1 (Fig. 1,c): exopod three-segmented and shorter than the corresponding endopod; the first segment with a spiniform seta near the outer corner, the third segment with four distal setae, the two main ones are geniculated. Endopod two-segmented; first segment as long as the first two segments of the exopod with a lateral seta inserted at $2/3$ of the length; second segment with two geniculated distal setae, the inner one is the longest.

P2: exopod (Fig. 1,e) three-segmented; third segment with three distal setae; endopod (Fig. 1,h) two-segmented, somewhat shorter than the first two segments of the corresponding exopod, first segment with a long, slender, transformed seta, second segment with one long and strong apical seta.

P3: exopod (Fig. 1,l) three-segmented, third segment with three apical setae; endopod (Fig. 1,q) two-segmented, shorter than the first two segments of the corresponding exopod; the proximal segment is smooth, the distal one has a long apical seta.

P4: exopod (Fig. 1,n) three-segmented; distal segment with three apical setae and a transformed one on the inner margin. Endopod (Fig. 1,m) two-segmented, a little longer than the first segment of the corresponding exopod; the second segment is very short with a strong transformed apical seta.

P5 (Fig. 1,p): represented by two almost quadrangular plates; the distal inner corner is prolonged in a long and slightly curved tip; the distal margin has two spiniform setae and a long seta; another long seta is inserted on the distal outer corner.

P6 (Fig. 1,i): a little plate with two setae, the outer one is the longest one.

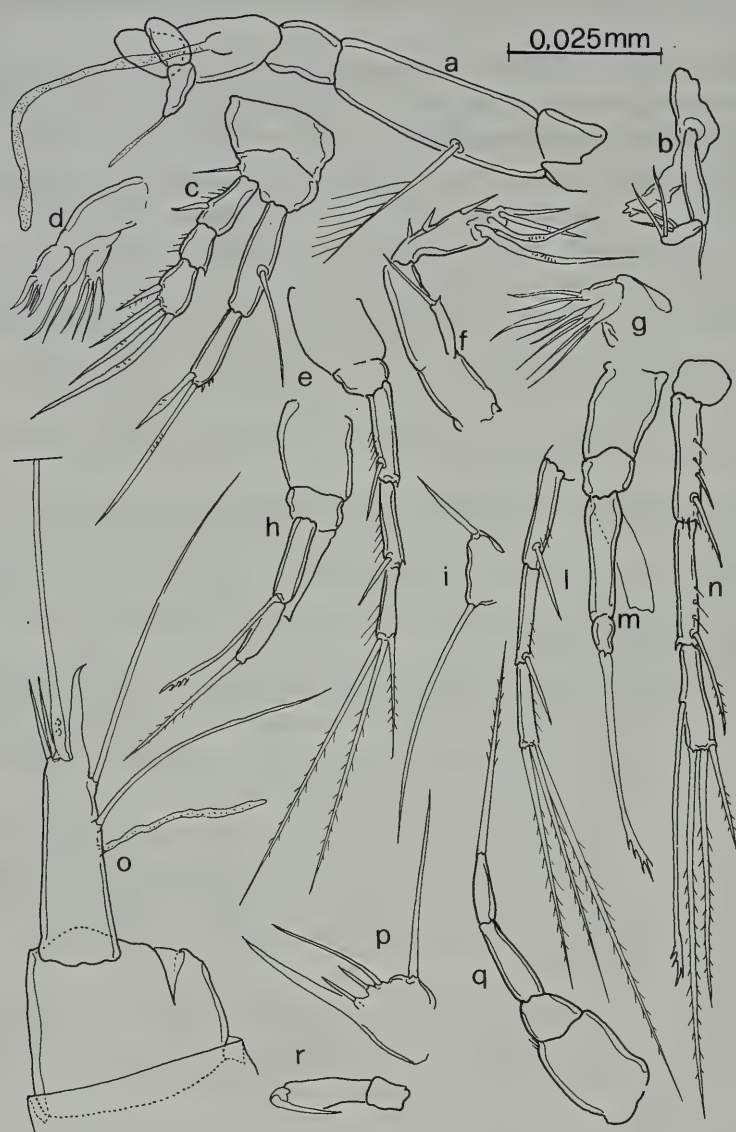


Fig. 1 - *Arenopontia (Neoleptastacus) phreatica* n. sp.. Male holotype. a - rostrum and antennula; b - mandible; c - P1; d - maxillula; e - P2 exopod; f - antenna; g - maxilla; h - P2 endopod; i - P6; l - P3 exopod; m - P4 endopod; n - P4 exopod; o - caudal rami and anal operculum; p - P5; q - P3 endopod; r - maxilliped.

Setal formula of *Arenopontia phreatica* n. sp.

P1		P2		P3		P4	
exp.	endp.	exp.	endp.	exp.	endp.	exp.	endp.
0.0.022	1.011	0.0.121	1.010	0.0.021	0.010	0.0.121	0.0.10

DERIVATIO NOMINIS - The name of the new species derives from the adjective "phreaticus", from the Greek "frear" = well.

***Arenopontia* (*Neoleptastacus*) *spelunca* e n.sp.**

MATERIAL - 6 females and 5 males collected at different times in interstitial waters of Tiberio beach (Sperlonga, Latina province, Latium) (M.C. Bruno legit, 1988-1990), on the banks of a little stream that originates from a spring on the beach, at the bottom of the calcarean cliff on which Sperlonga village is built. 2 females (V. Cottarelli, F. Venanzetti legg., 10.5.1990) collected in the interstitial freshwater of S. Agostino beach (Gaeta, Latina province, Latium), on the banks of a little stream that originates from a spring, in a cave named "Grotta del Serpente", and reaches the sea crossing the beach.

TYPES - Holotype: a female, dissected and mounted on a slide labelled *Arenopontia speluncae* ht.

PARATYPES - The remaining specimens, mounted on slides, labelled *Arenopontia speluncae* pt., and numbered from 2 to 13. The type material is temporarily deposited in the senior Author's collection at the "Dipartimento di Scienze Ambientali", Università della Tuscia, Viterbo.

DIAGNOSIS - An *Arenopontia* of medium size characterized, among other things, by the arrangement of the following features: second segment of the P2 endopods bringing only an apical seta; second segment of the P3 exopod with one internal seta.

DESCRIPTION OF THE HOLOTYPE - Body cylindrical and lenghtened, without pigment. Photoreceptors absent. Body lenght, from the tip of the rostrum to the distal edge of the caudal rami: 0,394 mm. The distal edge of the somites is smooth.

Rostrum (Fig. 2,p): as long as the first segment of A.1.

Anal operculum (Fig. 3,c): with smooth and curved edge.

Caudal rami (Fig. 3,c): a little longer than the last abdominal segment, ending with a curved tip, with a main apical seta surrounded by two shorter ones and another setae on the dorsal distal margin; two setae are inserted at the $2/3$ of the dorsal margin.

Antennula (Fig. 2,p): six-segmented, second segment more developed than the other ones, with a lateral hairy seta. Fourth segment prolonged in an apophysis bearing a long aesthetasc and one seta; another shorter aesthetasc is inserted at the top of the last segment; remaining ornamentation is shown in figure.

Antenna (Fig. 2,o): exopod one-segmented with two apical setae one of which is narrow and spiniform; endopod two-segmented, ornamentation is shown in figure.

Mandible (Fig. 2,d): praecoxa with dentate *pars incisiva*; palpum well developed, two-segmented; second segment with four apical setae and one on the lateral margin.

Maxillula (Fig. 2,m): arthrite of the praecoxa with four distal addenda; coxa with two distal setae; basis with three distal setae; endopod and exopod reduced to a seta each one.

Maxilla (Fig. 2,g): endopod reduced to a tubercle with two setae; basis prolonged in a distal claw accompanied by a seta; two endites with respectively two and one seta.

Maxilliped (Fig. 2,l): basis and first segment of the endopod smooth; second segment of the endopod with a distal claw.

P1: exopod (Fig. 3,a) three-segmented, shorter than the endopod; first segment with a lateral seta; third segment with three apical setae, the two main ones geniculated, and another one on the outer lateral margin; first segment of the endopod (Fig. 3,b) smooth and longer than the first two segments of the corresponding exopod, with one seta at half length of the segment, the distal segment with two apical setae.

P2 (Fig. 3,e): exopod three-segmented, with three apical pennate setae on the distal segment; two-segmented endopod, second segment with a long apical pennate seta and another one on the inner lateral

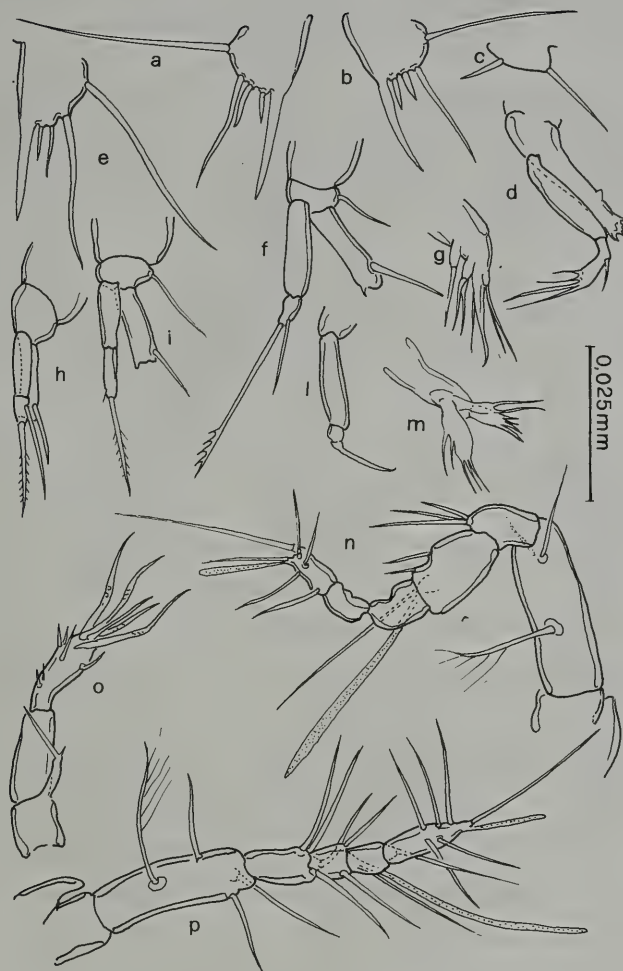


Fig. 2 - *Arenopontia (Neoleptastacus) speluncae* n. sp.. Female holotype: Figs: a, d, g, l, m, o, p. Female paratype: e. Male paratype: b, c, f, h, i, n. a P5; b - P5; c - P6; d - mandible; e - P5; f - P4 endopod; g - maxilla; h - P2 endopod; i - P3 endopod; l - maxilliped; m - maxillula; n - antennula; o - antenna; p - rostrum and antennula.

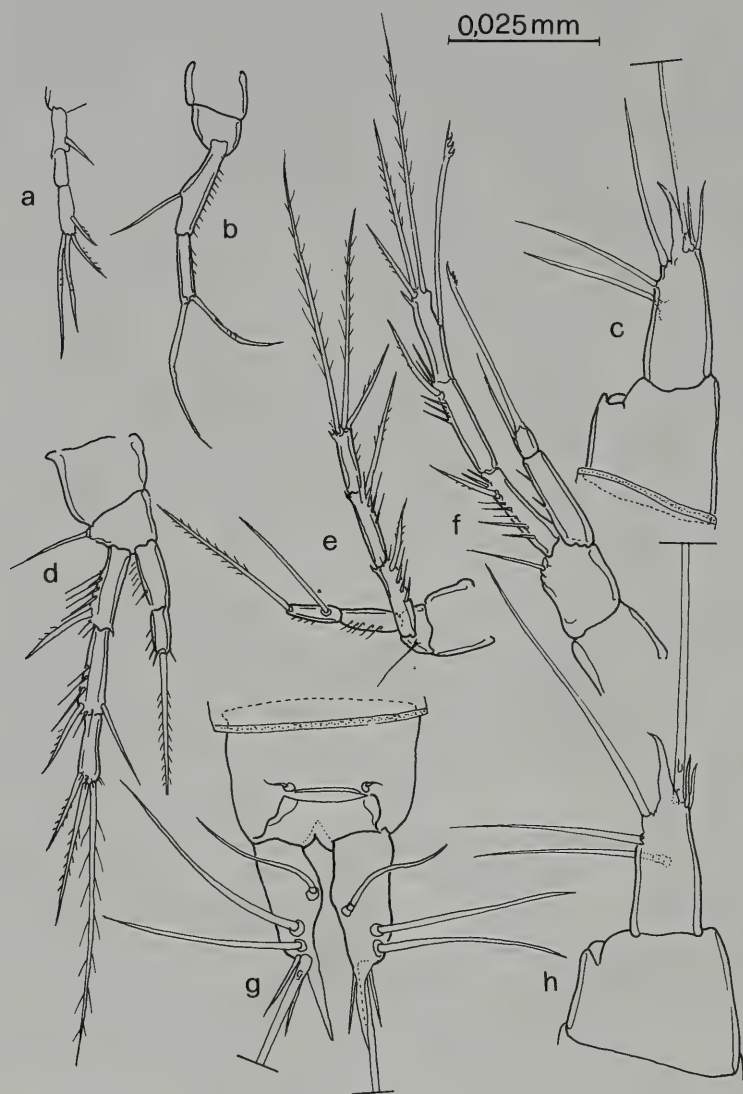


Fig. 3 - *Arenopotia (Neoleptastacus) speluncae* n. sp.. Female holotype: a, b, c, d, e, f. Female paratype: g. Male paratype: h. a - P1 exopod; b - P1 endopod; c - caudal rami and anal operculum; d - P3; e - P2; f - P4; g - caudal rami and anal operculum; h - caudal rami, lateral view.

margin.

P3 (Fig. 3,d): exopod three-segmented, the second segment with one distal seta on the inner margin, the third one with three pennate setae of different length on the distal margin. Endopod two-segmented, longer than the first segment of the exopod, distal segment with an apical seta.

P4 (Fig. 3,f): three-segmented exopod, the last segment with three distal setae, a long and narrow transformed seta can be observed on the inner lateral margin; two-segmented endopod, a little longer than the first segment of the exopod; on the second segment, which is the shortest, an apical transformed seta and a subapical one can be seen.

P5 (Fig. 2,a): represented by two almost quadrangular plates, the inner distal corner is prolonged in a strong and slightly curved tip; the distal edge with two spiniform setae and a longer third one; a long seta on the outer corner.

DESCRIPTION OF THE MALE - Body length, measured as in the female: 0,346 mm.

Anal operculum, rostrum, antennae, mouth appendages, P1, P3, P5 (Fig. 2,b) similar to female's ones.

Caudal rami (Fig. 3,h): a little shorter than the female's ones.

Antennula (Fig. 2,n): seven-segmented, ornamentation is shown in figure.

P2: endopod (Fig. 2,h) two-segmented, with the same ornamentation of the female's one but shorter; the second segment with a pennate apical seta and a inner lateral one. Exopod similar to the female's one.

P3: endopod (Fig. 2,i) similar to female's one but shorter.

P4: (endopod (Fig. 2,f) two-segmented, a little shorter than the female's one.

P6 (Fig. 2,c): reduced to a little plate with two setae.

Setal formula of *Arenopontia speluncae* n. sp. (fem.)

P1		P2		P3		P4	
exp.	endp.	exp.	endp.	exp.	endp.	exp.	endp.
0.0.022	1.011	0.0.120	0.110	0.1.111	0.010	0.0.121	0.011

DERIVATIO NOMINIS - The name of the new species is derived from the latin substantive "spelunca" = cave, that was the ancient name of Sperlonga village.

VARIABILITY - All the features of the typical series appear to be constant; we show, however, the last abdominal segment, anal operculum, caudal rami and P5 of a female specimen collected in S. Agostino (Figs. 2,e; 3,g) beach.

AFFINITIES - The two new species here discussed bring an unjointed claw on P5, the exopods and endopods of P2-P4 are respectively three and two segmented, the third segment of the P4 exopod brings an internal seta; they belong then, according to WELLS 1967 and to BODIOU and COLOMINES 1986, to the subgenus *Neoleptastacus*. Five species belonging to this group (*A. longiremis* Chappuis, 1954 *accraensis* Lang, 1965, *indica* Rao, 1967, *gussoae* Cottarelli, 1973, *sakagamii* Ito, 1978) show only one apical seta on the P3 endopod, as it happens in our species. These new species, however, differ from all the other species mentioned below, because the second segment of the P2 endopod brings only one apical seta instead of two. Besides, *A. (Neol.) phreatica* n. sp. brings one seta on the first segment of P2 endopod. These features are also present in *A. (Neol.) africana* Chappuis and Rouch, 1961, and in *A. (Neol.) angolensis* Kunz, 1971, but these two species have one-segmented P2 and P3. As regards particularly *A. (Neol.) speluncae* n. sp., this species has one internal seta on the second segment of the P3 exopod, which is always lacking in all the other *Arenopontia* that have been described till now., *A. (Neol.) phreatica* n. sp., instead, has only one distal seta on the second segment of P4 endopod; the same situation is present only in *A. (Neol.) africana*.

It seems to us, then, that the two species here discussed are so well characterized to be considered good species, and that they are

more similar to each other than to *A. (Neol.) acantha* Chappuis, 1954, which is the most diffused species in the Mediterranean basin.

REMARKS - The record of these new *Arenopontia* allows the authors to modify their unpublished data and data presented in literature, concerning the ecology of the genus. Until now, the genus *Arenopontia* included only species belonging to marine meiobenthos; an exception is represented by some populations of *A. (A.) cfr. subterranea* (COTTARELLI 1969 b; COTTARELLI & VENANZETTI 1989) that, as concerns the researches carried out in Italy, have been found not only in waters of marine origin, but also in interstitial habitats where a contribution of freshwater exists, in the following localities: the mouth of Trigno river, Abruzzi, in 1976, (Folchini, unpublished data); the shore of S. Agostino near Gaeta, Latium in 1986 (Venanzetti unpublished data); the shore of Tiberio on the litoral of Sperlonga, Latium (see text); the mouth of Ombrone river, Tuscany, (Cottarelli, unpublished data).

As concerning *A. (Neol.) speluncae* n. sp., periodic researches have been carried out monthly for two years in 1988-90 (Bruno, unpublished data) to collect the few number of specimens indicated before: seven specimens were found in freshwater where no other *Arenopontia* live, and the other specimens were collected in slightly brackish waters together with a large population of *A. (A.) cfr. subterranea*. Therefore in this sampling station the *Arenopontia* specimen appear to be spatially distributed along a salinity gradient.

The new species has been found in freshwater or in the part of the shore where the contribution of freshwater is prevalent; in addition to the above mentioned *A. (A.) cfr. subterranea*, which represents the largest amount of the specimens collected here, *Parastenocaris amyclaea* Cottarelli, 1969 b, *Psammopsyllus maricae* Cottarelli et al., 1983, *Ichnusella pasquinii* (Cottarelli), 1969 a, have been found.

In the part of the shore characterized by highly brackish or salty waters, *A. (Neol.) acantha* Chappuis, 1954 is prevalent, together with a few number of specimens belonging to *A. (A.) cfr. subterranea*. Finally, *A. (Neol.) acantha* is the sole species collected in the sampling stations where the interstitial water is exclusively of marine origin.

On these basis, it is possible to make some first remarks about the ecology of *Arenopontia (Neol.) speluncae* n. sp.: since the species is missing from the highly brackish and marine interstitial waters, it

seems possible that its habitat is represented by the area of the shore with a conspicuous amount of freshwater, but we think that this hypothesis is not reliable for the low number of specimens collected in these interstitial waters (we want to emphasize that the reserches were carried out monthly for two years). We think that it is possible to argue that the few specimens collected belong to a population living in the phreatic waters under the calcareous hill on which Sperlonga village lies.

As concerning *Arenopontia* (Neol.) *phreatica*, this species lives in freshwaters of a deep water bearing stratum, but the only specimen collected doesn't allow to make any hypothesis about the population. These *Arenopontia* are part of those forms of marine origin that have colonized, or that are colonizing the continental subterranean waters, in a way that can be similar to that followed by *Ichnusella pasquinii* and *Psammopsyllus maricae*, both belonging to the *Cylindropsyllidae* family. We think that the colonization process presented by *A. (Neol.) speluncae* fits well the model of active colonization proposed and discussed by Rouch and Danielopol 1987.

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RIASSUNTO

Nel presente lavoro vengono descritte e discusse *Arenopontia* (*Neoleptastacus*) *phreatica* n. sp. e *Arenopontia* (*Neoleptastacus*) *speluncae* n. sp., rinvenute rispettivamente in un pozzo artesiano a 73 metri di profondità sull'Isola di La Maddalena (SS), e in due stazioni di acque dolci interstiziali sulla spiaggia di Tiberio (Sperlonga, LT) e di S. Agostino (Gaeta, LT). Le nuove specie si distinguono da tutte le altre appartenenti al sottogenere per la presenza di una setola invece di due sul secondo segmento dell'endopodite del P2. *A. (neol.) speluncae* n. sp. è inoltre caratterizzata dalla presenza di una setola interna sul secondo segmento dell'esopodite P3, che manca in tutte le altre specie; *A. (Neol.) phreatica* è caratterizzata dalla presenza di una setola distale sul secondo segmento dell'endopodite P4, caratteristica presente solo in *A. africana*.

Il lavoro è completato da alcune considerazioni sulla particolare ecologia delle specie qui descritte, le prime rinvenute in acque dolci.

SUMMARY

In this paper the authors describe and discuss some Harpacticoids of the genus *Arenopontia* belonging to two new species: *A. (Neoleptastacus) phreatica* n. sp. and *A. (Neoleptastacus) speluncae* n. sp. The first species was collected in phreatic waters in La Maddalena island (Sardinia, SS), the second one in the interstitial waters of the beach near Sperlonga village (Latium, LT) and of S. Agostino beach, near Gaeta town (Latium, LT).

As it has been discussed, these *Arenopontia* seem to be very interesting not only for the taxonomic and biogeographic but also for the ecological aspect: in fact, this is

the first record in subterranean freshwater of specimens belonging to the genus.

The description and discussion of the two species has been followed by some remarks and hypothesis about the origin of the colonization process.